What is claimed is:

1. An operation control apparatus of a reciprocating compressor, comprising:

a compressor including a searching coil;

a first stroke estimator that estimates a first stroke value by using a voltage, a current applied to a motor of the compressor and a motor constant;

a phase difference detector that detects a phase difference between a phase of the first stroke value and a phase of the current applied to the motor;

a searching coil voltage detector that detects a voltage applied to both ends of the searching coil based upon the phase difference detected by the phase difference detector;

a counter electromotive force extractor that extracts a counter electromotive force induced by the searching coil in accordance with the phase difference detected by the phase difference detector;

a second stroke estimator that estimates a second stroke value based upon the extracted counter electromotive force; and

a controller that compares the second stroke value with a stroke reference value and varies one of a voltage applied to the motor and an operational frequency of the compressor in accordance with a result of the comparison.

2. The apparatus of claim 1, wherein the first stroke estimator estimates the first stroke value by using the following equation

$$X = \frac{1}{\alpha}\int(V_M - Ri - L\dot{i})dt$$

wherein, V_M is the motor voltage, i is a motor current, R is resistance of the motor, L is inductance of the motor, and α is a motor parameter.

3. The apparatus of claim 1, wherein the controller detects a voltage applied to the both ends of the searching coil when a difference between a phase of the first stroke value and a phase of the current applied to the motor is 90°.

4. The apparatus of claim 1, wherein the controller varies an operational frequency of the motor when a difference between a phase of the first stroke value and a phase of the current applied to the motor is not 90°.

5. The apparatus of claim 1, wherein the searching coil voltage detector detects a voltage applied to both ends of the searching coil by using following Equation

$$E1 = N\frac{d\Phi_A}{dt} + \alpha\bar{x}$$

wherein, N is the number of times that the coil is wound around the motor, Φ_A is magnetic flux of the motor, α is a motor constant, and $\bar{x}$ is a piston speed.

6. The apparatus of claim 1, wherein the counter electromotive force extractor extracts the counter electromotive force from the voltage applied to both ends of the searching coil by using following Equation

$$E3 = \alpha\bar{x}$$

herein, α is a motor constant, and $\bar{x}$ is a piston speed.

7. The apparatus of claim 6, wherein a magnitude of the counter electromotive force is calculated by multiplying sinθ by a magnitude of the voltage applied to the both ends of the searching coil, wherein θ is a difference between a motor magnetic flux phase and a voltage phase applied to the both ends of the searching coil.

8. The apparatus of claim 1, wherein the second stroke estimator estimates a second stroke value by using the following Equation

$$x = \frac{1}{\alpha} \int (\alpha \bar{x})\, dt$$

wherein, α is a motor constant, and x is a piston speed value.

9. An operation control apparatus of a reciprocating compressor that estimates a first stroke value based upon a current and a voltage applied to a compressor motor and performs stroke control with the estimated stroke value, the operation control apparatus of a reciprocating compressor comprising:

a searching coil voltage detector that detects a voltage applied to both ends of a searching coil;

a counter electromotive force extractor that extracts a counter electromotive force based upon the voltage applied to the both ends of the searching coil;

a second stroke estimator that estimates a second stroke value based upon the extracted counter electromotive force; and

a controller that compares the second stroke estimation value with a stroke reference value and one of varies a voltage applied to the motor and an operational frequency of the compressor in accordance with a result of the comparison.

10. A method of controlling operation of a reciprocating compressor, comprising:

estimating a first stroke value by using a current and a voltage applied to a motor of a compressor and a motor constant;

calculating a difference between a phase of the first stroke estimation and a phase of the current applied to the motor and judging whether the difference is 90°;

detecting a counter electromotive force based upon a voltage applied to both ends of a searching coil when the phase difference is 90° and estimating a second stroke value with the counter electromotive force; and

comparing the second stroke value with a stroke reference value and varying a voltage applied to the motor based upon the result of the comparison.

11. The method of claim 10, further comprising increasing an operational frequency of the compressor when difference between a phase of the first stroke value and a phase of the current applied to the motor is greater than 90°.

12. The method of claim 10, further comprising decreasing an operational frequency of the compressor when a difference between phase of the first stroke value and a phase of the current applied to the motor is less than 90°.

13. The method of claim 10, wherein judging the second stroke value includes:

detecting a size and a phase of a voltage applied to both ends of the searching coil;

calculating a phase of a motor magnetic flux based upon a phase of the current applied to the motor;

calculating a magnitude of a counter electromotive force based upon a difference between the calculated phase of the magnetic flux and the phase of the voltage applied to both ends of the searching coil; and

calculating a second stroke value based upon the calculated size of the counter electromotive force.

14. The method of claim 13, wherein a magnitude of the counter electromotive force is calculated by multiplying $\sin\theta$ by a size of the voltage applied to both ends of the searching coil, wherein θ is difference between a phase of the motor magnetic flux and a phase of the voltage applied to both ends of the searching coil.

15. The method of claim 10, wherein varying the voltage varying includes:

comparing the second stroke value with a stroke reference value; and

increasing a voltage applied to the motor when the stroke reference value is greater than the second stroke value based upon a result of the comparison result.

16. The method of claim 15, wherein the varying further includes:

decreasing a voltage applied to the motor when the stroke reference value is less than the second stroke value based upon a result of the comparison.

17. In a method of controlling operation of a reciprocating compressor by estimating a stroke of a compressor motor and performing stroke control with the estimated stroke, the method comprising:

calculating a magnitude of a counter electromotive force when a difference between a phase of the estimated stroke and a phase of the current applied to the motor is 90°;

calculating a new stroke value based on the magnitude of the counter electromotive force; and

comparing the new stroke value with a stroke reference value and varying a voltage applied to the motor in accordance with a result of to the comparison.

18. The method of claim 17, wherein varying the voltage includes:

comparing a second stroke value with a stroke reference value; and

increasing a voltage applied to the motor when the stroke reference value is greater than the second stroke value based upon a result of the comparison.

19. The method of claim 18, wherein varying the voltage includes:

decreasing a voltage applied to the motor when the stroke reference value is less than the second stroke based upon a result of the comparison value in the comparison result.